

N O T I C E

THIS DOCUMENT HAS BEEN REPRODUCED FROM
MICROFICHE. ALTHOUGH IT IS RECOGNIZED THAT
CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED
IN THE INTEREST OF MAKING AVAILABLE AS MUCH
INFORMATION AS POSSIBLE



Technical Memorandum 82031

Interfaces Between Statistical Analysis Packages and the ESRI Geographic Information System

Edward Masuoka

(NASA-TM-82031) INTERFACES BETWEEN
STATISTICAL ANALYSIS PACKAGES AND THE ESRI
GEOGRAPHIC INFORMATION SYSTEM (NASA) 26 p
HC A03/MF A01 CSCL 05B

N81-15893

Unclas
G3/82 13149

OCTOBER 1980

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771



**INTERFACES BETWEEN STATISTICAL ANALYSIS PACKAGES
AND THE ESRI GEOGRAPHIC INFORMATION SYSTEM**

**Edward Masuoka
NASA/Goddard Space Flight Center**

October 1980

**GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland**

**INTERFACES BETWEEN STATISTICAL ANALYSIS PACKAGES
AND THE ESRI GEOGRAPHIC INFORMATION SYSTEM**

Edward Masuoka

NASA/Goddard Space Flight Center

Abstract

The Environmental Systems Research Institute (ESRI) geographic information system (GIS) in use at Goddard Space Flight Center provides users with the means of combining remote sensing data with ancillary data (soils maps, geologic maps, topographic maps, etc.) and performing qualitative analyses on the resulting multivariable data base. However, statistical techniques such as multiple regression, analysis of variance and spatial autocorrelation analyses are not available in the GIS. This paper describes interfaces between ESRI's GIS data files and real valued data files written to facilitate statistical analysis and display of spatially referenced multivariable data. An example of data analysis which utilized the GIS and the Statistical Analysis System (SAS) is presented to illustrate the utility of combining the analytic capability of a statistical package with the data management and display features of the GIS.

PRECEDING PAGE BLANK NOT FILMED

CONTENTS

	<u>Page</u>
Abstract	iii
INTRODUCTION	1
DESCRIPTION OF INTERFACES	2
RUNNING SAS2GIS AND GIS2SAS	3
COMBINING THE GIS AND A STATISTICAL PACKAGE FOR DATA ANALYSIS	3
REFERENCES	7
APPENDIX 1	A1-1
APPENDIX 2	A2-1
APPENDIX 3	A3-1

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1 Input Parameters for SAS2GIS	5
2 Input Parameters for GIS2SAS	6

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1 Structure of an ESRI GIS Multivariable File (MVF)	8
2 Logical Units Required by SAS2GIS	8
3 Logical Units Required by GIS2SAS	9
4 A Plot of Elevations in the Rio Grande Rift Study Area Produced By the ESRI GIS	9
5 Bouguer Gravity Values from the Rio Grande Rift Study Area	10
6 Residuals from a Regression of Elevation and Bouguer Gravity	10

PRECEDING PAGE BLANK NOT FILMED

INTERFACES BETWEEN STATISTICAL ANALYSIS PACKAGES AND THE ESRI GEOGRAPHIC INFORMATION SYSTEM

INTRODUCTION

Automated geographic information systems provide a framework in which spatially referenced data (maps and remote sensing imagery) may be manipulated, displayed and analyzed (Knapp, 1979). The utility of a geographic information system (GIS) lies in its ability to create and analyze a multivariable file derived from maps and images of a study area. Geographic information systems have been used by land planners to select sites for campgrounds in Canadian national parks (Arbour, 1980), by researchers at the National Cancer Institute to study patterns of mortality (Mason, 1980) and by geologists to examine relationships between petrologic and geophysical information on the moon (Andre et al., 1977).

The Environmental Systems Research Institute (ESRI) GIS provides the user with a tool for creating multivariable files from digitized map data and digital remote sensing data. A GIS multivariable file may be thought of as a cube made up of data cells. The horizontal axes of the cube correspond to geographic location. Along the vertical axes are the different variables in the multivariable file. Thus, each column of cells in the cube has a unique geographic location and each layer of cells in the cube corresponds to a unique thematic map variable, such as soil type, vegetation type or topographic elevations (see Figure 1). Analyses which can be performed on the multivariable files include: slope and aspect calculations, proximity analyses and the creation of qualitative models based on user supplied weights (ESRI staff, 1979). However, statistical analyses, such as multiple regression, analysis of variance and spatial autocorrelation analysis can not be performed within the GIS. Further, since observations in a GIS multivariable file are stored as sixteen bit integers, real values and integers outside the range $\pm 32,768$ can not be manipulated by the GIS.

The inability to perform statistical analyses on GIS multivariable files, precludes the development of powerful quantitative models for resource exploration or land use planning within the

GIS package. However, statistical packages, such as SAS, provide tools for performing a range of statistical analyses from the computation of simple descriptive statistics to complex multivariate techniques (Helwig and Council, 1979).

To provide a means of performing statistical analyses on variables in GIS files and to allow the results of these analyses to be merged with GIS multivariable files, interfaces between the ESRI GIS and real valued data files were created.

DESCRIPTION OF INTERFACES

SAS2GIS is a computer program which converts gridded real valued data into the single variable file (SVF) format used by the ESRI geographic information system. The data file of real values that is to be converted to an integer SVF must be sorted so that for a SVF file n rows by m columns, the real value for cell (i, j) in the SVF will correspond to entry $(i*m+j)$ in the real valued data file. The conversion is accomplished by a linear transformation, $y=ax+b$, which maps a real valued variable X into an integer variable Y . The program provides the user with two options for converting the data into integer format. First, the user may supply the a and b terms of $y=ax+b$. Second the user may specify a range for the transformed data. The original data will be mapped into this range using the linear transformation and the transformed data will be checked to insure that the conversion did not truncate the values more than a user specified amount. After the transformed data have been written to a disk file, an additional record is added to the file which contains the a and b terms that were used to make the transformation. This record is not read by any GIS software but may be used by the interface GIS2SAS to convert the SVF file to a real valued data file.

GIS2SAS is a computer program which transforms integer data in ESRI's SVF format into real valued data with row column references. The formula used to convert integer data to real valued data is $x=(y-b)/a$; where x is a real value, y is an integer and a and b are constants. The user has two options for converting integers to real values. First, the user may specify a and b

terms for the transformation. This is required if the SVF file was not created by SAS2GIS. Second, if no a and b values were provided by the user the program will use the a and b values in the last record written by SAS2GIS when the file was created. Program output consists of a real valued data file in a format specified by the user.

RUNNING SAS2GIS AND GIS2SAS

SAS2GIS and GIS2SAS are interactive computer programs written in FORTRAN IV. At Goddard Space Flight Center they run in the foreground on an IBM 360/91 and an IBM 360/75. Listings of these programs appear in Appendix 1. The clists (files which contain TSO commands and subcommands) used to set up and run the interfaces are presented in Appendix 1. To run a program the user types the program's name, SAS2GIS or GIS2SAS, followed by I ("input filename") and O ("output filename"). For example if the user types:

SAS2GIS I(BOTANY.DATA) O(GIS.DATA)

the program SAS2GIS will be run to create an SVF file GIS.DATA from a real valued data file BOTANY.DATA.

When the programs are running in the foreground they will prompt the user for two lines of input. The first line contains parameters used to make the transformations and the second line is the format of the real valued data file. Tables 1 and 2 summarize the input parameters for these interfaces.

Should the user wish to convert these interfaces to run in a batch environment, he must make two modifications. First, the clists must be replaced by JCL statements which assign disk files for input and output to logical units 8 and 10, as shown in Figures 2 and 3. Second, the write statements which prompt the user for input should be removed.

COMBINING THE GIS AND A STATISTICAL PACKAGE FOR DATA ANALYSIS

Some preliminary results in an analysis of gravity and elevation data from the Rio Grande rift are presented here to illustrate the utility of combining a package of statistical analysis

programs, SAS, with the ESRI geographic information system (GIS). The objective of this study was to remove the relationship between Bouguer gravity and topographic relief which was present in a data set of elevation and gravity observations compiled by Keller and Conrad at the University of Texas.

The gravitational field measured at a given point on the earth's surface includes effects unrelated to geology. These effects are due to: variations in the distance between the earth's center and the station where the gravity field was measured and the contribution of local topography to the observed gravity (Grant and West, 1965). Once corrections for these effects have been applied to the data, the resulting values are termed Bouguer gravity data and reflect the contribution of underlying geologic structures.

At present there is no agreement on the best method for computing Bouguer gravity from the observed gravity which is measured at a station. However, Nettleton (1940) has suggested that when the corrections to reduce observed gravity to Bouguer gravity are properly applied, the correlation between station elevation and Bouguer gravity should be low. A striking similarity between the Bouguer gravity and station elevation was first observed in three dimensional plots of these two data types produced by the GIS. In order to determine the degree of correlation between the gridded elevation data from the rift (Figure 4) and gridded Bouguer data (Figure 5), the statistical analysis package SAS76 was used to compute a Pearson product moment correlation coefficient. The correlation between Bouguer gravity and elevation was high, -0.903 , and a linear regression was computed to remove the variation in Bouguer gravity due to elevation. The residuals from the regression provide a better estimate of Bouguer gravity because the effect of station elevation has been removed. A plot of these residuals, Figure 6, reveals regions of high positive residuals in the North-west and South-east corners of the Rio Grande study area. This suggests that there are regional variations in rock density in the study area and that individual Bouguer gravity corrections should be calculated for each region.

In this analysis the Statistical Analysis System (SAS) and the ESRI GIS proved useful tools for examining the relationship between variables in a spatially referenced multivariable database.

With these interfaces the researcher can utilize the extensive data base management and graphics capabilities of the GIS to complement existing software in the analysis of real valued multivariate data.

Table 1
Input Parameters for SAS2GIS

Parameter	Column	Format	Function
First Input Line			
ROW	1-5	I5	Number of rows in the SVF which will be created from the input data file.
COLUMN	6-10	I5	Number of columns in SVF.
A	11-15	F5.0	Multiplicative term in $y=ax+b$, used to map real x into integer y .
B	16-20	F5.0	Additive term in $y=ax+b$, if A and B are omitted NEWMIN and NEWMAX must be specified.
MIN	26-30	F5.0	Minimum value of input data default: value calculated by the program.
MAX	26-30	F5.0	Maximum value of input data default: value calculated by program.
NEWMIN	31-37	I5	New minimum value after transformation to integers.
NEWMAX	38-44	I5	New maximum value after transformation to integers.
TOLER	45-49	F5.0	User specified tolerance for truncation resulting from conversion of real values to integer format.
MISVAL	50-55	F6.0	Value indicating missing observations in the data.
NEWVAL	56-61	F6.0	Value which will be assigned to missing observations in the SVF file, default: 0.
Second Input Line			
FMT	1-80	80A1	User supplied input format for data in real data set.

Table 2
Input Parameters for GIS2SAS

Parameter	Column	Format	Function
First Line of Input			
A	1-6	F6.0	Divisor in $x=(y-b)/a$ used to transform integer values into real values default: use first value in last record of SVF file.
B	7-12	F6.0	b term in $x=(y-b)/a$ used to transform integer values into real values default: use second value in last record of SVF file.
Second Line of Input			
NCOL	1-3	I3	# columns in output file.
Third Line of Input			
FMT	1-80	80A1	User supplied output format for real valued data set.

REFERENCES

1. Andre, C., M. Bielefeld, E. Eliason, L. Soderblom, I. Adler, and J. Philpotts, 1977, "Lunar surface chemistry: a new imaging technique." *Science* 197: 986-989.
2. Arbour, J. H., 1980, "The use of a biophysical (ecological) data base for park planning," *Proceedings of the international symposium on cartography and computing: applications in health and environment*, vol. 1, p. 515-523.
3. Environmental Systems Research Institute staff, 1979, *ESRI geographic information software descriptions*. 79 p.
4. Grant, F. and G. West, 1965, *Interpretation theory in applied geophysics*, McGraw-Hill, New York, 584 pp.
5. Helwig, J. T. and K. A. Council, 1979, *SAS user's guide*. SAS Institute, 494 p.
6. Knapp, E., 1978, "Landsat and ancillary data inputs to an automated geographic information system: Applications for urbanized area delineation." *CSC T.R.-78 6019*, 82 p.
7. Mason, T., 1980, "A mechanism for selecting communities at high risk for cancer." *Proceedings of the international symposium on cartography and computing: applications in health and environment*, vol. 1, p. 26-32.
8. Nettleton, L., 1940, *Geophysical prospecting for oil*, McGraw-Hill, New York.

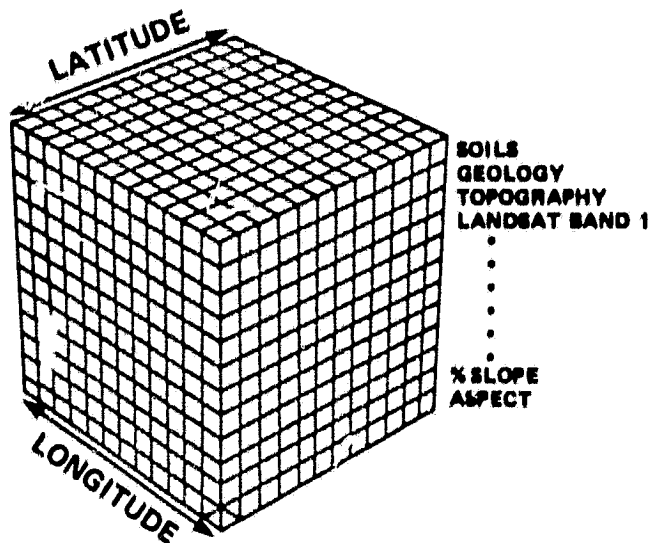
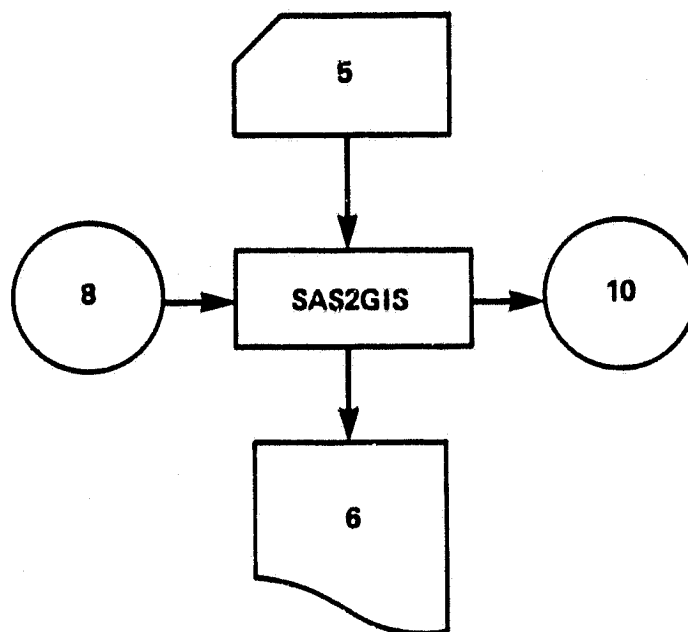
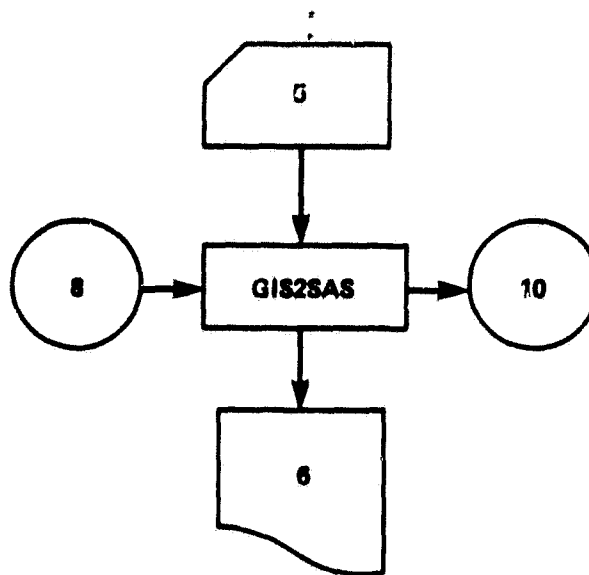


Figure 1. Structure of an ESRI GIS Multivariable File (MVF)



<u>UNIT</u>	<u>STRUCTURE</u>	<u>COMMENT</u>
5	CARD	USER CONTROL CARDS
6	PRINTER	JOB LISTING
8	CARD	REAL VALUED DATA FILE
10	SVF	INTEGER SINGLE VARIABLE FILE

Figure 2. Logical Units Required by SAS2GIS



UNIT	STRUCTURE	COMMENT
5	CARD	USER CONTROL CARDS
6	PRINTER	JOB LISTING
8	SVF	INTEGER SINGLE VARIABLE FILE
10	CARD	REAL VALUED DATA FILE

Figure 3. Logical Units Required by GIS2SAS

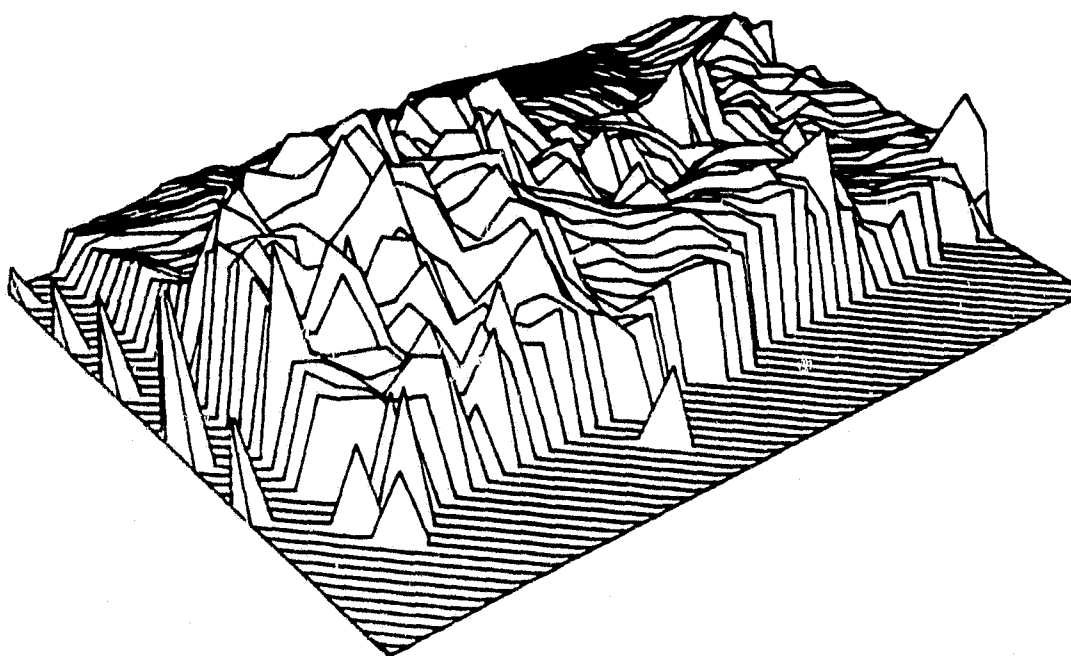


Figure 4. A Plot of Elevations in the Rio Grande Rift Study Area Produced by the ESRI GIS

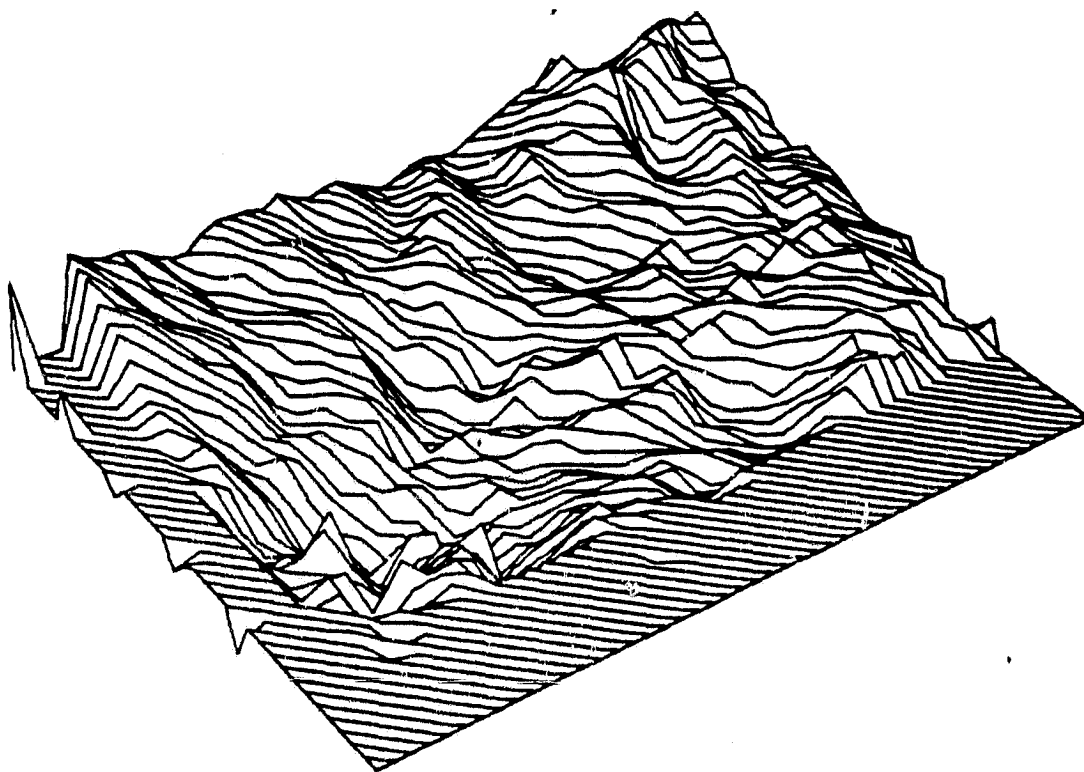


Figure 5. Bouguer Gravity Values from the Rio Grande Rift Study Area

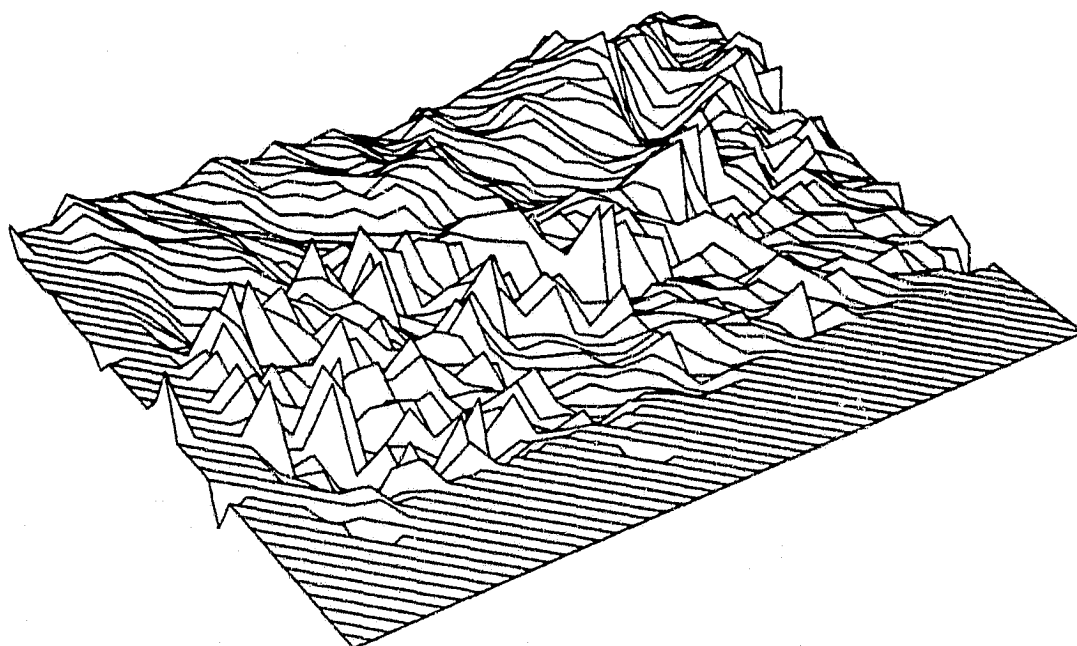


Figure 6. Residuals from a Regression of Elevation and Bouguer Gravity

APPENDIX 1

PROGRAM LISTINGS OF THE INTERACTIVE INTERFACES BETWEEN REAL VALUED DATA SETS AND THE ESRI GEOGRAPHIC INFORMATION SYSTEM

A. SAS2GIS PROGRAM LISTING

```

*****
*
*  TITLE:  INTERFACE FOR REAL VALUED DATA AND
*  ESRI GIS SINGLE VARIABLE FILES (SVF'S)
*  PROGRAMMER:  EDWARD MASUOKA
*  DATE:  AUGUST 1, 1979
*
*  THIS PROGRAM TRANSFORMS REAL VALUED DATA SETS
*  INTO INTEGER*2 DATA IN GIS FORMAT IN 3 STEPS:
*
*  1.  PROMPTS USER FOR FORMAT OF INPUT DATA AND
*      PARAMETERS USED TO MAP REAL VALUES
*      INTO INTEGERS
*
*  2.  MAKES REAL VALUES INTO INTEGER*2
*      WITHIN THE RANGE -32,768 TO +32,768
*      WITH A LINEAR TRANSFORMATION
*
*  3.  WRITES THE ESRI/GIS FILE AND INFORMATION
*      REQUIRED TO TRANSFORM THE GIS FILE TO
*      REAL VALUED DATA, AS THE LAST RECORD
*      OF THE SVF FILE.
*
*  USER INPUT:
*
*  CARD 1 1-5  NROW  # ROWS IN INPUT FILE
*          5-10 NCOL  # COLUMNS IN INPUT FILE
*          11-15 A    MULTIPLICATIVE TERM IN Y=AX+B
*                   USED TO MAP REAL X
*                   INTO INTEGER Y
*          16-20 B    ADDITIVE TERM IN Y=AX+B
*          21-25 MIN  MINIMUM VALUE OF INPUT DATA
*                   DEFAULT: CALCULATED
*          26-30 MAX  MAXIMUM VALUE IN INPUT DATA
*                   DEFAULT: CALCULATED
*          31-37 NTRMIN INTEGER MINIMUM AFTER
*                   TRANSFORMATION
*          38-44 NTRMAX INTEGER MAXIMUM AFTER
*                   TRANSFORMATION
*          45-49 TOLER  USER SPECIFIED TOLERANCE
*                   FOR TRUNCATION RESULTING FROM
*                   THE TRANSFORMATION OF REAL
*                   VALUES TO INTEGERS
*                   DEFAULT: .0001
*          50-55 MISVAL VALUE FOR MISSING
*                   OBSERVATIONS
*                   DEFAULT: -9999
*          56-61 NTRVAL VALUE ASSIGNED TO MISSING
*                   OBSERVATIONS IN SVF FILE
*                   DEFAULT: 0
*
*  LINE 2 1-60  FMT  DESK SUPPLIED FORMAT (2014)

```



```

DO 22 J=1, NCOL
IF (DATA(J) .LT. MIN) MIN=DATA(J)
IF (DATA(J) .GT. MAX) MAX=DATA(J)
22 CONTINUE
IF (MIN .GT. NEWVAL .OR. MIN .EQ. MISVAL) MIN=NEWVAL
IF (MAX .LT. NEWVAL .OR. MAX .EQ. MISVAL) MAX=NEWVAL
REWIND 8

CALCULATE A AND B FOR SCALING FUNCTION Y=AX+B
300 RANGE=NEWMAX+1.-NEWMIN
IF (NEWMAX+NEWMIN .LT. ABS(NEWMAX+NEWMIN)) RANGE=RANGE-1.
A=RANGE/(MAX-MIN)
B=RANGE-A*MAX

*****
*          PRINT INTERMEDIATE RESULTS          *
*****

WRITE(6,0) MIN,MAX
6  FORMAT(1H, 'MIN=', F10.5/, 'MAX=', F10.5)
WRITE(6,9) A, B
9  FORMAT(1H, 'A=', F12.5/1H, 'B=', F12.5//)

*****
*          WRITE THE SVF                      *
*****

CHECK TO INSURE THAT THE TRANSFORMED VALUES HAVE NOT
BEEN TRUNCATED MORE THAN A USER SPECIFIED TOLERANCE
CALL CHKTRC(DATA, NCOL, A, B, TOLER)
WRITE ROW AND COLUMN INFORMATION ON THE SIS FILE
999 WRITE(10) ROWCOL
SCALE THE DATA FROM + RANGE TO - RANGE
DO 30 I=1, NROW
READ(8, FM1, END=99) (DATA(J), J=1, NCOL)
DO 40 J=1, NCOL
IF (DATA(J) .EQ. MISVAL) DATA(J)=NEWVAL
ROW(J)=(A*DATA(J)+B)
40 CONTINUE

WRITE THE TRANSFORMED OBSERVATIONS A ROW AT A TIME
CALL WRITEC(ROW, NCOL)

```

30 CONTINUE

WRITE THE COEFFICIENTS USED TO MAKE THE TRANSFORMATION
AND THE FORMAT OF THE REAL VALUED DATA SET
AS THE LAST RECORDS OF THE TRANSFORMED FILE

WRITE (10) AB
WRITE (10) FMT
WRITE (6, 11)

11 FORMAT (1H0//, '++++ SUCCESSFUL CONVERSION TO ESRI SVT FILE +++++')
STOP 1

ERROR MESSAGES FOR INCORRECT CONTROL CARDS

99 WRITE (6, 3)
3 FORMAT (1H, 'TOO FEW OBSERVATIONS ')
STOP 2
END

* THIS SUBROUTINE WRITES THE INTEGERS *
* AS A SINGLE VARIABLE FILE *

SUBROUTINE WRITEC (RCW, NCOL)
INTEGER*2 RCW (NCOL)
WRITE (10) RCW
RETURN
END

* THIS SUBROUTINE COMPARES THE ORIGINAL REAL VALUED *
* DATA FILE WITH THE REAL VALUED FILE WHICH WILL BE *
* PRODUCED IF THE SVT IS TRANSFORMED BACK TO A REAL *
* VALUES IF THE DIFFERENCE BETWEEN *
* ENTRIES IN THESE FILES EXCEEDS A USER SPECIFIED *
* TOLERANCE AN ERROR MESSAGE IS WRITTEN AND THE JOB *
* IS ABORTED. *

SUBROUTINE CHECKC (DATA, NCOL, A, B, TOLER)
INTEGER*4 NCOL
REAL*4 DATA (NCOL), A, B, TOLER, RDAT
INTEGER*2 IDAT

CALCULATE EFFECT OF TRANSFORMATION ON
VALUES OF THE INPUT DATA

DO 10 I=1, NCOL
IDAT=DATA(I)*A+B

```

RCAT=ICAT
RDAT=(RDAT-E)/A

```

```

*****
*  CCMPEASE ORIGINAL REAL VALUE WITH REAL VALUE  *
*  WHICH RESULTS FROM TRANSFORMING GIS FILE BACK *
*  TO A REAL FILE USING SLOPE AND INTERSEPT CALCULATED *
*  FROM THE USER SPECIFIED RANGE FOR TRANSFORMED DATA *
*  TOLFRANCE CREATE THE GIS FILE *
*****

```

```
IF (ABS(RDAT-DATA(I)) .LT. TOLER) GO TO 10
```

ELSEF WRITE AN ERROR MESSAGE AND STOP

WRITE (0, 1)

```

WRITE(6,1)
FORMAT(1H, '*****' TOLERANCE EXCEEDED DURING TRANSFORMATION!
1, '*****')

```

STOP 2
CONTINUE
RETURN
END

B. GIS2SAS PROGRAM LISTING

```

*****
*
*   TITLE:  INTERFACE BETWEEN ESRI GEOGRAPHIC
*           INFORMATION SYSTEM SVF DATA SETS
*           AND REAL VALUED DATA SETS USED BY
*           STATISTICAL PACKAGES
*
*   PROGRAMMER:  EDWARD MASUCKA
*
*   DATE:  AUGUST 1, 1979
*
*   THIS PROGRAM TRANSFORMS GIS FILES IN INTEGER*2
*   INTO THE ORIGINAL REAL VALUED DATA IN 3 STEPS:
*
*   1.  READS ROW COLUMN INFORMATION FROM RECORD 1
*
*   2.  TRANSFORMS INTEGERS TO REAL VALUES USING
*       A LINEAR TRANSFORMATION:  REAL=(INTEGER-3)/A
*
*   3.  WRITES THE REAL DATA TO A FILE WITH A
*       USER SUPPLIED FORMAT
*
*
*   VARIABLE      FUNCTION
*
*   DATA         STORES REAL DATA
*   ROWCOL        STORES # OF ROWS AND COLUMNS
*                 IN THE INPUT FILE
*   ROW           # OF ROWS IN DATA AND GIS FILE
*   COLUMN        # COLUMNS IN DATA & GIS FILE
*   AB            STORES LINEAR TRANSFORM PARAMS
*   SLOPE         SLOPE OF LINEAR FUNCTION USED
*                 TO TRANSFORM REAL DATA
*   INTER        INTERSEPT OF LINEAR TRANSFORM
*   IROW         STORES 1 ROW OF THE TRANSFORMED
*                 DATA
*
*   FMT          USER SUPPLIED FORMAT FOR REAL
*                 VALUED DATA SET
*
*****

REAL*4 DATA(150), AB(2), SLOPE, INTER
INTEGER*2 ROWCOL(2), IROW(150)
INTEGER*4 ROW, COLUMN, FMT(20), BLNK/' '/
LOGICAL*1 BUFFER(80)
EQUIVALENCE (AB(1), SLOPE), (AB(2), INTER), (BUFFER(1), FMT(1))

READ USER SUPPLIED OUTPUT FORMAT AND PARAMETERS

WRITE(6,4)
4  FORMAT(1H0,110,'PLEASE INPUT A (F5.0) B(F5.0) TERMS'/
        1H ,110,'WHICH WILL BE USED TO MAKE THE TRANSFORMATION'/

```

```

      1H ; (DEFAULT: IF ZERO, PROGRAM WILL USE LAST RECORD OF SVF) '/'
      1H ; A B
      1H ; SLOPE, INTER
11  READ (5,1) SLOPE, INTER
    FORMAT(2E5.0)
    WRITE (6,2)
2   FORMAT(2) 'PLEASE INPUT # OF COLUMNS FOR OUTPUT DATA SET: (13) '/'
    ' DEFAULT: IF ZERO, PROGRAM WILL USE # COLUMNS IN SVF')
    READ (5,6) NCCL
6   FORMAT(13)
    WRITE (6,8)
8   FORMAT(2) 'PLEASE INPUT FORMAT FOR REAL VALUED DATA SET: (80A1) ',
    '/1HC, ' DEFAULT: LAST RECORD OF SVF WILL BE USED')
    READ (5,1) FMT
1   FORMAT(80A1)

    READ AND ECHO # ROWS AND COLUMNS IN GIS FILE

    READ (8) ROWCCL
    ROW=ROWCCL(1)
    CCLUMN=ROWCCL(2)
    WRITE (6,3) ROW, CCLUMN
3   FORMAT(1H0/110, 'ROWS=', T22, I5/1X, T10, 'COLUMNS=', T22, I5)
    IF (SLOPE .NE. 0 .OR. INTER .NE. 0) GO TO 40

    SPACE FAST TRANSFORMED DATA

    DO 30 I=1, ROW
    CALL REACC(IROW, COLUMN, 8)
30  READ AND ECHO PARAMETERS USED TO TRANSFORM ORIGINAL REAL DATA

    READ (8) AB
40  WRITE (6,5) SLOPE, INTER
5   FORMAT(1H , T10, 'SLOPE=', T19, F8.3/1X, T10, 'INTERSEPT=', T21, F8.3)

    CHECK FOR USER SPECIFIED FORMAT

    DO 50 I=1, 20
    IF (FMT(I) .NE. BLNK) GO TO 60
50  CCNTINUE

    NCNE FOUND USE LAST RECORD OF SVF

    READ (8, END=99) FMT
60  FFWIND 8

    TRANSFORM THE DATA INTO ORIGINAL VALUES
    A ROW AT A TIME

    IF (NCCL .EQ. 0) NCCL=CCLUMN
    READ (3) ROWCOL
    DO 10 I=1, ROW

```

```

      CALL READC (IROW, COLUMN, R)
      DO 20 J=1, CCOLUMN
20    DATA (J) = (IRCW (J) - INTER) / SLOPE
      WRITE THE REAL VALUED DATA FILE
      10 CALL WRITEC (DATA, NCCL, FMT, 10)
      WRITE (6, 12)
      12 FORMAT (/ 1H0, '++++ SUCCESSFUL CONVERSION TO REAL VALUED FILE ++++')
      //
      STOP 1
      99 WRITE (6, 100)
      100 FORMAT (1H0, 110, '***** FATAL ERROR: NO FORMAT SPECIFIED',
      . ' BY USER AND NO FORMAT ON SVF *****')
      STOP 2
      END

```

```

*****
*   THIS SUBROUTINE READS A SVF FORMAT FILE   *
*   *****

```

```

SUBROUTINE READC (IRCW, CCOLUMN, LUNIT)
INTEGER*4 CCOLUMN
INTEGER*2 IROW (CCOLUMN)
READ (LUNIT) IROW
RETURN
END

```

```

*****
*   THIS SUBROUTINE WRITES THE REAL VALUED DATA *
*   WITH A USER SPECIFIED FORMAT               *
*   *****

```

```

SUBROUTINE WRITEC (DATA, CCOLUMN, FMT, LUNIT)
INTEGER*4 CCOLUMN
REAL*4 DATA (CCOLUMN), FMT (20)
WRITE (LUNIT, FMT) DATA
RETURN
END

```

APPENDIX 2

CLISTS

A. CLIST FOR SAS2GIS

```
PROG O INFILE (REAL.DATA) OUTFILE (SAS.GIS)
CALLOC DA (&INFILE.) F (FT08F001)
ALLOC DA (&OUTFILE.) N SP (10, 1) TR U (GIS)
CALLOC DA (&OUTFILE.) F (FT10F001)
DO SAS2SVF LIB (PROG.LOAD)
```

B. CLIST FOR GIS2SAS

```
PROG O INFILE (SAS.GIS) OUTFILE (REAL.DATA)
CALLOC DA (&INFILE.) F (FT08F001)
CALLOC DA (&OUTFILE.) N SP (10, 10) TR U (FORT)
CALLOC DA (&OUTFILE.) F (FT10F001)
ALLOC DA (*) F (FT05F001)
ALLOC DA (*) F (FT06F001)
DO SVF2SAS LIB (PROG.LOAD)
```


APPENDIX 3

AN EXAMPLE OF THE OUTPUT FROM THE INTERACTIVE
PROGRAMS, SAS2GIS AND GIS2SAS. PROGRAM OUTPUT IS IN
UPPERCASE AND USER INPUT IS IN LOWERCASE LETTERS.

A. EXAMPLE OF RUNNING SAS2GIS

sas2gis infile (real.data) outfile (elev2.svf)

INPUT: ROW COLUMN A B MIN MAX NEW_MIN NEW_MAX
TOLERANCE MISS_VAL NEW_VAL USING.
(2I5, 2F5.0, 2F5.0, 2F7.0, F5.0, 2F6.0)

```
.... 5 ... 10 ... 15 ... 20 ... 25 ... 30 ... 35 ... 40 ... 45 ... 50 ... 55 ... 60
      +      +      +      +      +      +      +      +      +      +
      36     48     1.     0.
      ROWS =      36
      COLUMNS =   48
      SLOPE =      1.000
      INTERSEPT =  0.0
```

PLEASE INPUT FORMAT OF REAL VALUED DATA
(10f8.0)

+++ SUCCESSFUL CONVERSION TO ESRI SVF FILE ++++
IH0002I STOP 1
CONDITION CODE = 01

B. EXAMPLE OF RUNNING GIS2SAS

gis2sas infile (elev.svf) outfile (real.data)

PLEASE INPUT A (F5.0) B (F5.0) TERMS WHICH WILL BE USED TO MAKE
THE TRANSFORMATION
(DEFAULT: IF ZERO, PROGRAM WILL USE LAST RECORD OF SVF)

```
      A      B
.... + .... +
      1.     0.
```

PLEASE INPUT # OF COLUMNS FOR OUTPUT DATA SET: (I3)
DEFAULT: IF ZERO, PROGRAM WILL USE # COLUMNS IN SVF

PLEASE INPUT FORMAT FOR REAL VALUED DATA SET: (80A1)
DEFAULT: LAST RECORD OF SVF WILL BE USED
(10f8.0)

ROWS = 36 ;
COLUMNS = 48
SLOPE = 1.000
INTERSEPT = 0.0

++++ SUCCESSFUL CONVERSION TO REAL VALUED FILE +++++

IH0002I STOP 1
CONDITION CODE = 01